DOE–EM/GJTAC1640

Office of Environmental Management – Grand Junction

UMTRA Project

Moab UMTRA Project
Flood Mitigation Plan

Revision 3

May 2014

U.S. Department of Energy

Office of Environmental Management

Prepared by the Technical Assistance Contractor under contract number DE-EM0002067
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

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Moab UMTRA Project Flood Mitigation Plan

Revision 3

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Revision History

Revision No.	Date	Reason/Basis for Revision
0	May 2008	Initial issue.
1	May 2011	Annual update.
2	May 2013	Annual update.
3	May 2014	Annual update includes incorporation of new ground water and surface water data.

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Acronyms and Abbreviations

CF	Configuration
cfs	cubic feet per second
DOE	U.S. Department of Energy
ft	feet
IA	interim action
msl	mean sea level
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
POD	Plan of the Day
RAC	Remedial Action Contractor
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
USGS	U.S. Geological Survey
VFD	variable frequency drive

1.0 Introduction

The U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site (Moab site) is a former uranium ore-processing facility located about three miles northwest of the city of Moab in Grand County, Utah, and lies on the western bank of the Colorado River at the confluence with the Moab Wash.

Several features of the Moab site are shown in Figure 1. The site is transected by the Moab Wash, which flows during significant storm events. North of the wash is a freshwater intake structure that supplies a pond used for irrigation, dust control, and injection water as part of ground water interim action (IA) remediation.

The IA well field is located between the toe of the tailings pile and the river south of the Moab Wash. The site is susceptible to flooding because about 160 acres of the nearly 480 acres of the property are within the 100-year floodplain of either the Colorado River or the Moab Wash.

A berm located along the Colorado River north of the Moab Wash berm and several off-pile areas of the site have been remediated. A 20-acre area north of the Moab Wash (northern off-pile area) was remediated in the winter of 2010/2011 by excavating and removing the contaminated soil. As part of this remediation, the berm that was installed along the riverbank by the previous site owner was removed. In addition, more than 158,000 cubic yards of contaminated soil were removed from this area during the remediation, creating areas of lower elevation. As was anticipated, this northern off-pile area is now more susceptible to flooding at lower river stages.

Section 2.0 of this Plan provides information about river stage and flood predictions. Section 3.0 presents the trigger points that mandate specific actions, Section 4.0 provides guidance on specific steps in flood preparation, and Section 5.0 provides guidance to the steps that should be taken after the flood water has receded.

1.1 Purpose and Scope

This Plan is intended to minimize adverse impacts on DOE-owned or -managed property associated with the Moab Project from river flooding.

This plan is applicable to flooding that may occur at or near the Moab site and outlines the planning and actions to be taken by the Technical Assistance Contractor (TAC) and Remedial Action Contractor (RAC) in preparation for possible flood conditions. In the event of flooding, the *Moab UMTRA Project Emergency/Incident Response Plan* (DOE-EM/GJ1520) will be utilized. The *Emergency/Incident Response Plan* contains a Flood Action Plan checklist that includes actions to be taken (e.g., notifications, evaluations) when the RAC Operations/Site Manager calls a Flood Alert.

1.2 Background

Stream flow on the Colorado River has been collected by the U. S. Geological Survey (USGS) at gaging station 09180500 near Cisco, Utah, since 1914. This station, located approximately 35 miles upstream of the site, is the closest station to Moab and provides the most complete data set representing river flow passing the site. There are no significant tributaries between the gaging station and the Moab site. In 2009, the Project installed a standard USGS-style river staff gage at the freshwater intake structure, just west of the freshwater pond at the eastern (upstream) end of the site. The elevation of the Colorado River surface is recorded from the gage on a routine basis.

On average, the river reaches a maximum flow between late May and early June, with an average annual instantaneous peak runoff at the Cisco gage of 27,500 cubic feet (ft) per second (cfs). Above-average runoff is attributed to a combination of above-average snowpack in the Upper Colorado River Basin, late spring precipitation events, and above-average temperatures. Peak flows within the last 50 years reached more than 40,000 cfs 12 times, with the two highest peak flows occurring in 1983 and 1984 (61,900 and 70,300 cfs, respectively).

During the springs of both 1983 and 1984, the Moab site was reportedly flooded up to the toe of the tailings pile. The most recent site flooding event occurred in 2011 (Figure 2), when the peak runoff reached 48,600 cfs, which is equivalent to a river surface elevation of 3,967.2 ft mean sea level (msl) on June 9, and the river flow remained above the average annual peak flow from late May through mid-July. The impacts of this flooding event are well documented in the *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007).

1.3 Site Condition

Figure 3 represents a rating curve generated using the 2011 flows for the site based on the river flows measured at the Cisco gaging station and the corresponding river surface elevation measured at the site river intake structure.

Ground surface elevation shows a low point on the riverbank south of the freshwater pond with an elevation of 3,957 ft msl (Figure 2). Using the rating curve, the associated river surface elevation for flows above 11,000 cfs will exceed the land surface elevation at this location, allowing river water to begin to migrate into the area. Once flows exceed approximately 33,000 cfs, the low point on the berm along the Moab Wash will be topped, and river water is expected to flow to the south within the constructed channel that runs through Configuration (CF) 5 from the Moab Wash. The southern end of the drainage has an elevation of 3,960 ft msl, so it is possible that the drainage will fill with surface water at a flow of approximately 19,000 cfs.

The bank along the river from the Moab Wash down to the southern end of CF4 has an elevation that generally ranges from 3,968 to 3,969 ft msl. However, the survey identified a low spot on the berm adjacent to the area between the infiltration trench and the baseline area, where the elevation is 3,967.2 ft msl. River flows above 48,000 cfs would allow the river to flow into the well field.

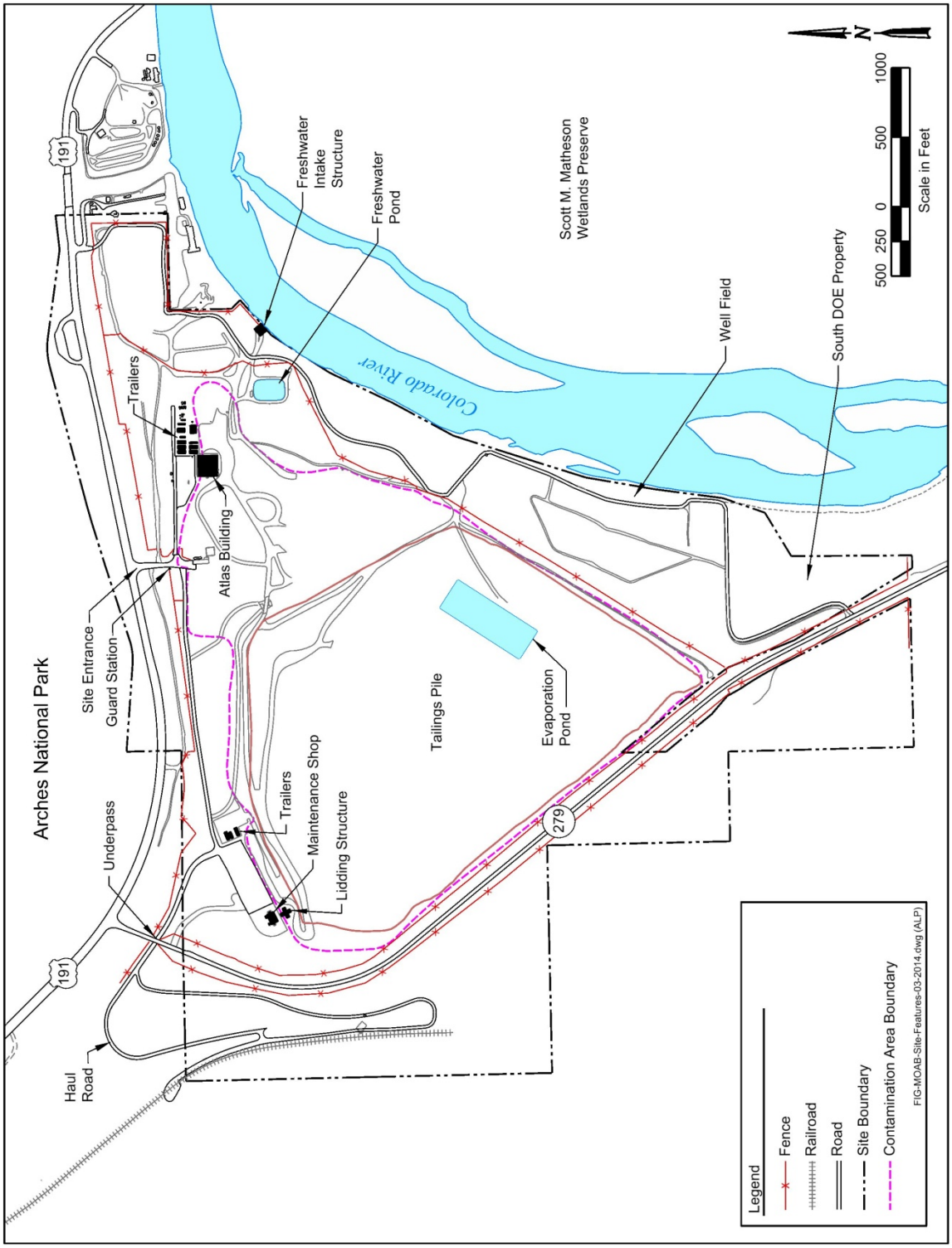

Figure 1. Moab Site Features

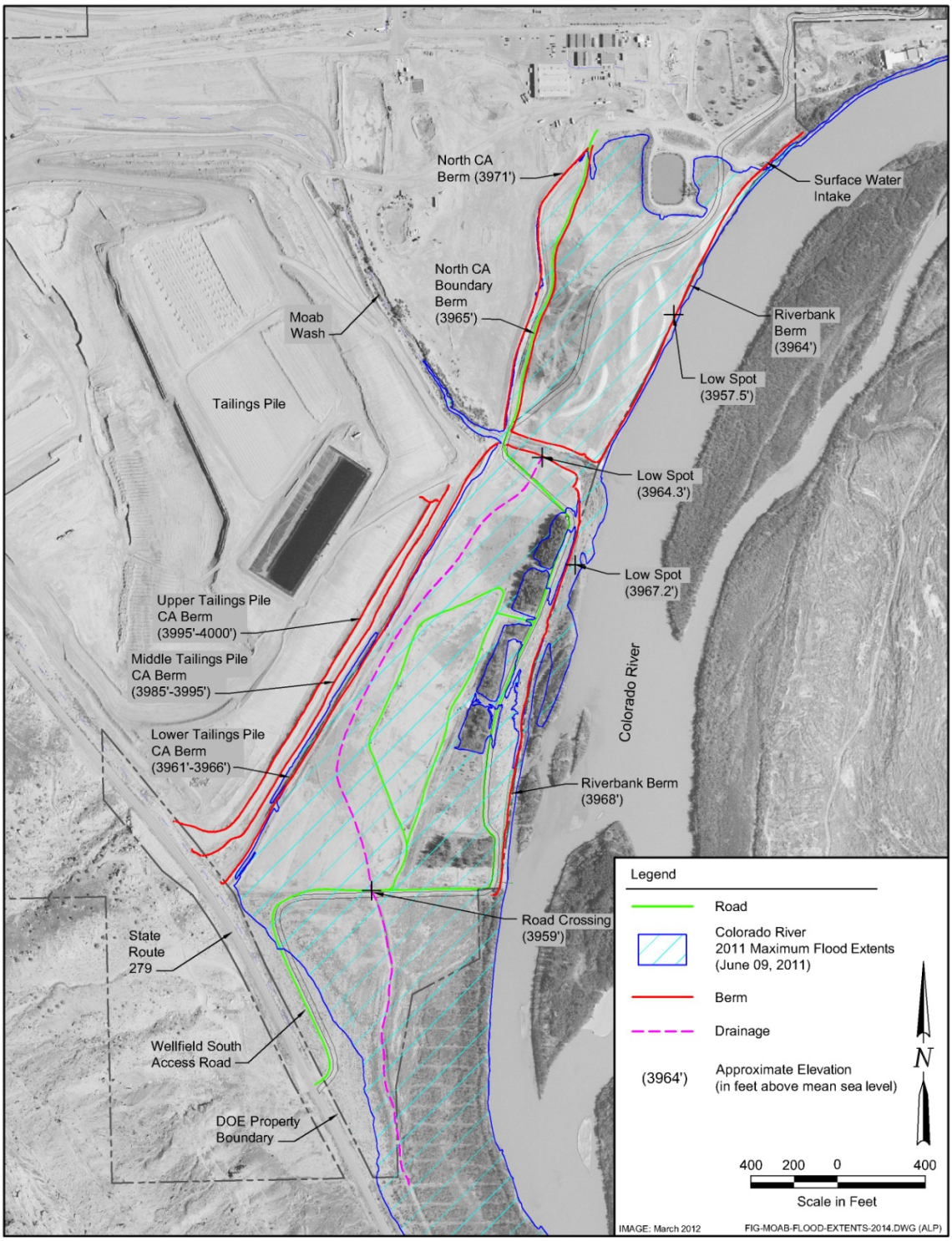

Figure 2. Moab Site Features, Colorado River Elevations and 2011 Flood Extent, and Contamination Area Berms and Elevations

Flow rates exceeding 60,000 cfs at the Cisco gage could potentially reach the toe of the tailings pile. Due to the wide girth of the river at Moab, even if inundated, there is insufficient energy in the river to adversely impact the tailings pile. Therefore, protection of the tailings pile from flooding is limited to maintaining the berms during lower river stages. Additional information is available in:

- Federal Emergency Management Agency, "Flood Insurance Study, Grand County, Utah," 2006.
- U.S. Geological Survey Scientific Investigations Report 2005-5022, "Initial Phase Investigation of Multi-Dimensional Streamflow Simulations in the Colorado River, Moab Valley, Grand County, Utah," 2004.

2.0 Monitoring Colorado River Stage

When the river flow rate at the Cisco gage is expected to exceed 15,000 cfs, the TAC monitors the current and forecast river stage daily and reports the status to the RAC in the Plan of the Day Meeting (POD).

2.1 Flood Designations

The National Weather Service (NWS) has a flood warning notification system that includes several flood designations applicable to the Moab site, including flash flood warning, flood warning, and river flood warning (http://www.nws.noaa.gov/floodsafety/index). The NWS reports forecast the river stage for 2 weeks.

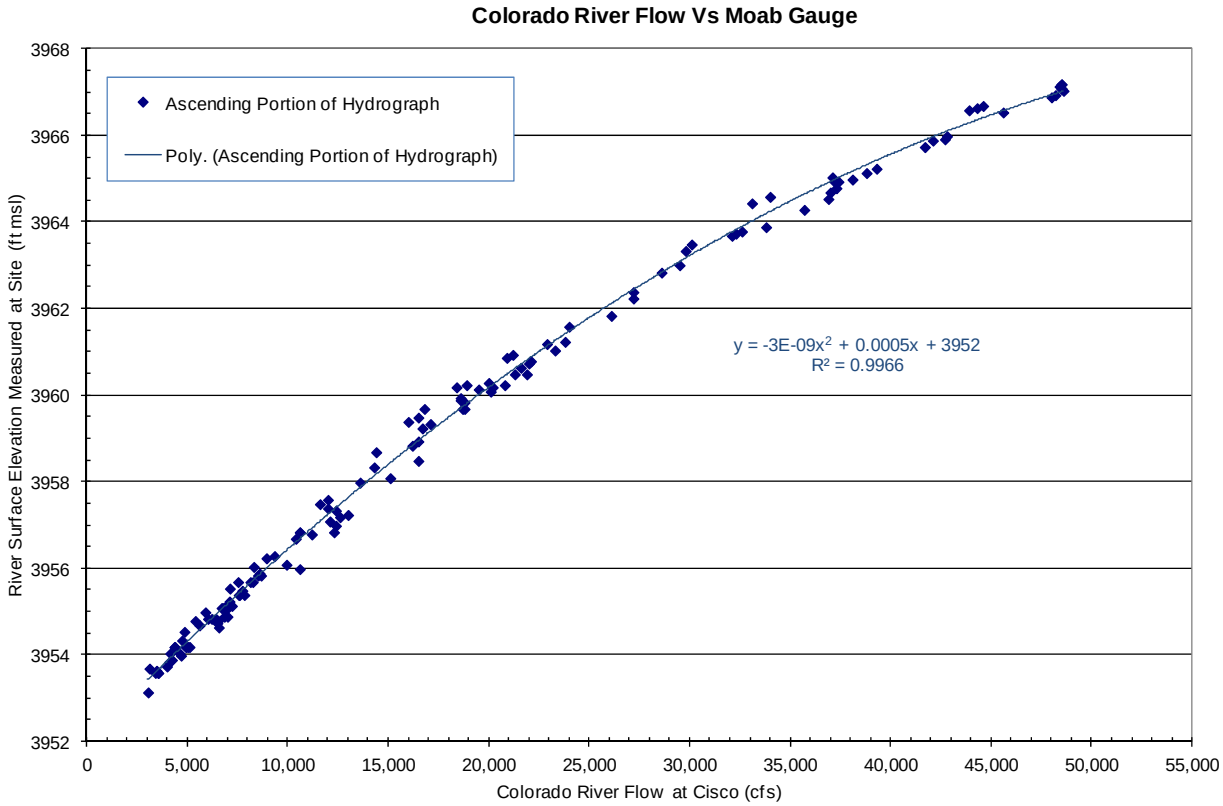

Figure 3. Cisco River Gage vs. Site Elevation Gage

Flood designations are described as follows.

Flash flood warning – Issued to inform the public, emergency management, and other cooperating agencies that flash flooding is in progress, imminent, or highly likely.

Flood warning – In hydrologic terms, a release by NWS to inform the public of flooding along larger streams that pose a serious threat to life or property. A flood warning will usually contain river stage (level) forecasts.

River flood warning – This warning is issued by the local NWS when the forecast points at specific communities (those that have formal gaging sites and established flood stages) or areas along rivers where flooding has been forecast, is imminent, or is in progress. Flooding is defined as the inundation of normally dry areas as a result of increased water levels in an established water course. The flood warning normally specifies crest information. It usually occurs 6 hours or later after the causative event, and it is usually associated with widespread heavy rain and/or snowmelt or ice jams.

The warning will contain the forecast point covered, the current stage (if it is available), and the established flood stage. From the forecast crest, the NWS determines which areas will be affected by the river flooding. This information is included in the warning that is issued as a site/event-specific call-to-action.

The TAC will monitor the NWS website and report any warnings to the RAC at the POD or will contact the Operations/Site Manager if an immediate threat occurs.

2.2 River Stage Reporting

Estimated Colorado River flow rates for the Cisco, Utah, gaging station (based on upstream flow rates and weather systems impacting the Colorado River basin) can be monitored on the National Oceanic and Atmospheric Administration (NOAA) website at http://www.cbrfc.noaa.gov/river/station/flowplot/flowplot.cgi?CLRU1. Figure 4 shows an example hydrograph from the Cicso gage.

The homepage to the Colorado Basin River Forecast Center can be found at www.cbrfc.noaa.gov.

In addition, the NOAA Western Water Supply Forecast web page, http://wateroutlook.nwrfc.noaa.gov/point/evolution?id=CLRU1&mode=r, provides a long-term seasonal runoff volume forecast that can be closely monitored.

3.0 Decision-making for Mitigating Potential Flood Damage

Table 1 provides a summary of the critical flows, the river surface elevation, and the areas of the site that will be impacted by flood waters as discussed in Section 1.3.

To avoid unnecessary efforts and associated costs with flood preparation, specific actions are triggered by observed river flow rates and stage forecasts for the Cisco gage. Taking the historical data into account, this Plan establishes conservative trigger points for action at 15,000 cfs, 25,000 cfs, and 35,000 cfs or greater.

These trigger points account for increases in flow rate that may occur over the weekend when site support is reduced. Figures A-1 through A-4 in Appendix A show the ground elevation and the elevation of specific river flows and how the site may be impacted.

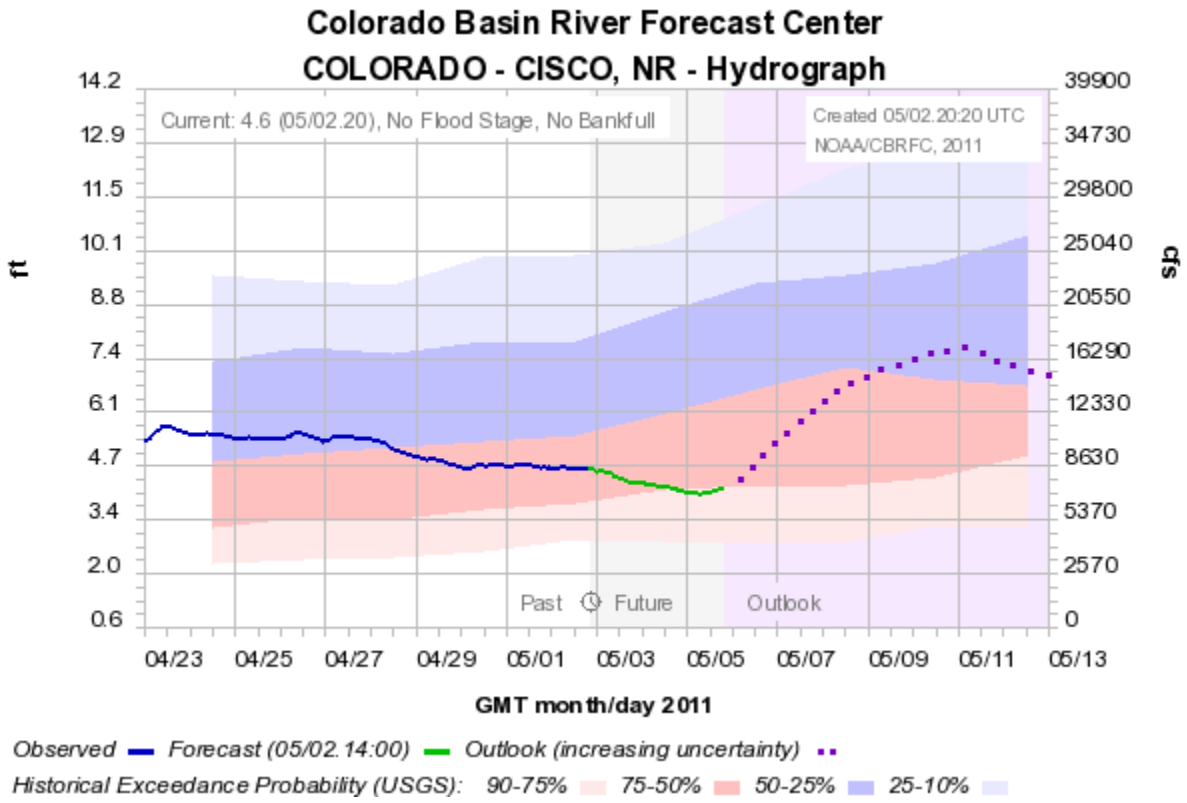

Figure 4. Example Hydrograph From Cisco, Utah, Gaging Station

Table 1. Key River Flows, River Surface Elevations, and Associated Areas Impacted

River Flow (cfs)	Elevation (ft msl)	Area Impacted
11,000	3,957	Surface water enters the surface depression just north of Moab Wash.
17,000	3,959.3	Ground water begins to daylight in the northern off-pile area. Surface water begins to back up into Moab Wash.
19,000	3,960	Surface water may enter the well field drainage via the southern DOE property.
29,500	3,963	Lower Moab Wash crossing is impassible.
33,000	3,964	Surface water will breach the southern Moab Wash berm into the well field.
48,000	3,967.2	Surface water expected to breach the riverbank along the well field.
60,000	3,969	Surface water will potentially reach the toe of the tailings pile.

3.1 Specific Actions at 15,000 cfs

The TAC will take the following actions associated with the well field once the Cisco gage flows are predicted to reach approximately 15,000 cfs.

- Coordinate with RAC to conduct a walkdown of areas to identify potentially vulnerable assets and establish corrective actions. Visually inspect berms and repair or enhance as needed.
- Shut down all freshwater injection into the well field when the river flow reaches 15,000 cfs.
- Verify all riverbed well point and observation well caps have been installed.
- Suspend irrigation activities in the northern off-pile area, and remove irrigation equipment that may be damaged or transported out of the area by flood waters.
- Ground Water personnel will notify RAC Moab Operations/Site Manager (or RAC On-call Manager, during non-working hours), who will then notify RAC and the TAC Technical Group/Field Manager, the DOE Facility Representative, the Federal Project Director, and TAC Public Affairs.

The RAC will take the following actions in other areas of the site once flows are predicted to reach 15,000 cfs.

- Inform site security and site personnel during daily safety briefing of flood-prone areas at the site where operations will be restricted for that day.

3.2 Specific Actions at 25,000 cfs

At flows of just above 25,000 cfs, well field access will be impacted by surface water backing up into the Moab Wash and onto the lower wash crossing. Once the Colorado River flows are predicted to reach 25,000 cfs at the Cisco gage, the TAC will perform the following tasks.

- Notify an electrician to schedule CFs 1, 3, and 4 transformer removal from the well field and variable frequency drive (VFD) removal from CF5.
- Shut down all power to the well field and secure power following the *Moab UMTRA Project Lockout/Tagout Hazardous Energy Control Procedure* (DOE-EM/GJ1552) to prevent inadvertent energization to the well field.
- Record all individual extraction/injection well flow meter values. Label and remove each well head flow meter display plate.
- Measure water levels at each monitoring well equipped with a data logger/pressure transducer. Label, download, and remove each data logger/pressure transducer.
- Complete berm inspections for erosion and signs of breaching.
- Inventory ground water shed and flammable cabinet in CF5. Remove any equipment that can be damaged by potentially rising water and relocate to higher ground.
- Check the power poles near the Moab Wash to determine if additional support is needed.
- Shut down the well field access road across the Moab Wash when deemed unsafe (historically occurs at a flow greater than 25,000 cfs).
- Well field access from the southern DOE property will also likely be submerged when the river flow is near 25,000 cfs. Water will back up from the main river channel into the new drainage channel, and it will be closed off to traffic when surface water reaches the road surface.

The RAC will take the following actions in other areas of the site at the 25,000 cfs level flow.

- Remove all RAC and TAC equipment stored in low-lying areas and transport to areas of the site that will not be impacted by higher flow rates.
- Remove all air-monitoring equipment from the well field.

3.3 Specific Actions at 35,000 cfs or Greater

For flows that are predicted to reach 35,000 cfs or greater, the TAC will perform the following tasks.

- Hold weekly (or more frequently as needed) meetings to discuss site actions and predicted river flow forecasts.
- Contact Williams Northwest Pipeline at 435-220-0139 to inform them that we are expecting a flow of greater than 35,000 cfs, so they will have time to remove electrical equipment from their equipment located adjacent to the river intake structure.
- Contact Enterprise to inform them that we are expecting a flow of greater than 40,000 cfs.
- Close the river intake pump head gate to avoid sediment from accumulating inside structure.
- Determine if signage is necessary to warn boaters about underwater hazards on the site.
- If the river reaches an elevation not encountered before, then actions will be taken as warranted by the site conditions.

3.4 Specific Actions for Moab Wash during Heavy Precipitation Events

In the event of heavy rainfall events that produce visible flow in the Moab Wash, the TAC will:

- Take photos of the wash flow (if the storm even occurs occurs during work hours).
- Close off access to lower crossing until flow stops and any sediment is scanned, cleaned, or removed.
- Collect samples for turbidity analysis from the Colorado River upstream and downstream of the Moab Wash confluence when deemed safe by RAC Health and Safety and TAC Safety, Health, and Quality.
- The upper wash crossing will also be closed while the wash is flowing, and employees in the Support Area will have to enter and exit the site off of State Route 279 until deemed safe by Safety, health, and Quality.

4.0 Specific Actions for Flood Mitigation

Representatives of the RAC and TAC will jointly observe the Colorado River bank and lower portion of the Moab Wash and associated berms to identify low points, erosional features, or loose soils that may be subject to further erosion during flooding. Objects that may be disrupted during flooding will be noted to determine if relocation or protection in place is preferred. Pay attention to possible hazardous materials (see list with security guards at the site entry kiosk) that may require special actions. The walkdown survey may result in corrective actions; any potential impacts/issues will be discussed with RAC Operations/Site Managers, and appropriate actions will be taken.

5.0 Specific Actions after Flood Water Recedes

Once the well field is accessible and there is no longer a threat of flooding or danger, the TAC will perform the following tasks:

- Assess any flood damage on the river berm and in the well field. Complete any necessary corrective actions.
- Contact the electricians to re-install the VFDs on the CF5 wells and re-install the transformers in CFs 1, 3, and 4.
- Return flow meter face plates to all of the wells.
- Return data loggers/pressure transducers to wells.
- Identify areas of standing water and determine whether mosquito abatement is necessary.
- Remove the lockout/tagout on the well field power.
- Resume well field extraction.
- Resume well field injection after the river flow drops to less than 15,000 cfs.
- Conduct a post-flood meeting will be held to discuss sediment removal from the Moab Wash lower crossing or other areas of the site and the repair of roads and berms.

The RAC will complete the following actions after the flood water has receded, and the area adjacent to the river is deemed safe.

- Radiologically scan the areas that flood for any potential contamination.
- Return air-monitoring stations to the well field.

6.0 References

DOE (U.S. Department of Energy) *Moab UMTRA Project Emergency/Incident Response Plan* (DOE-EM/GJ1520).

DOE (U.S. Department of Energy) *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007).

DOE (U.S. Department of Energy) *Moab UMTRA Project Lockout/Tagout Hazardous Energy Control Procedure* (DOE-EM/GJ1552).

Federal Emergency Management Agency, "Flood Insurance Study, Grand County, Utah," 2006.

National Oceanic and Atmospheric Administration at http://www.cbrfc.noaa.gov/river/station/flowplot/flowplot.cgi?CLRU1

National Oceanic and Atmospheric Administration Western Water Supply Forecast at http://wateroutlook.nwrfc.noaa.gov/point/evolution?id=CLRU1&mode=r

U.S. Geological Survey Scientific Investigations Report 2005-5022, "Initial Phase Investigation of Multi-Dimensional Streamflow Simulations in the Colorado River, Moab Valley, Grand County, Utah," 2004.

Appendix A.
Surface Water Elevation vs. Site Elevation

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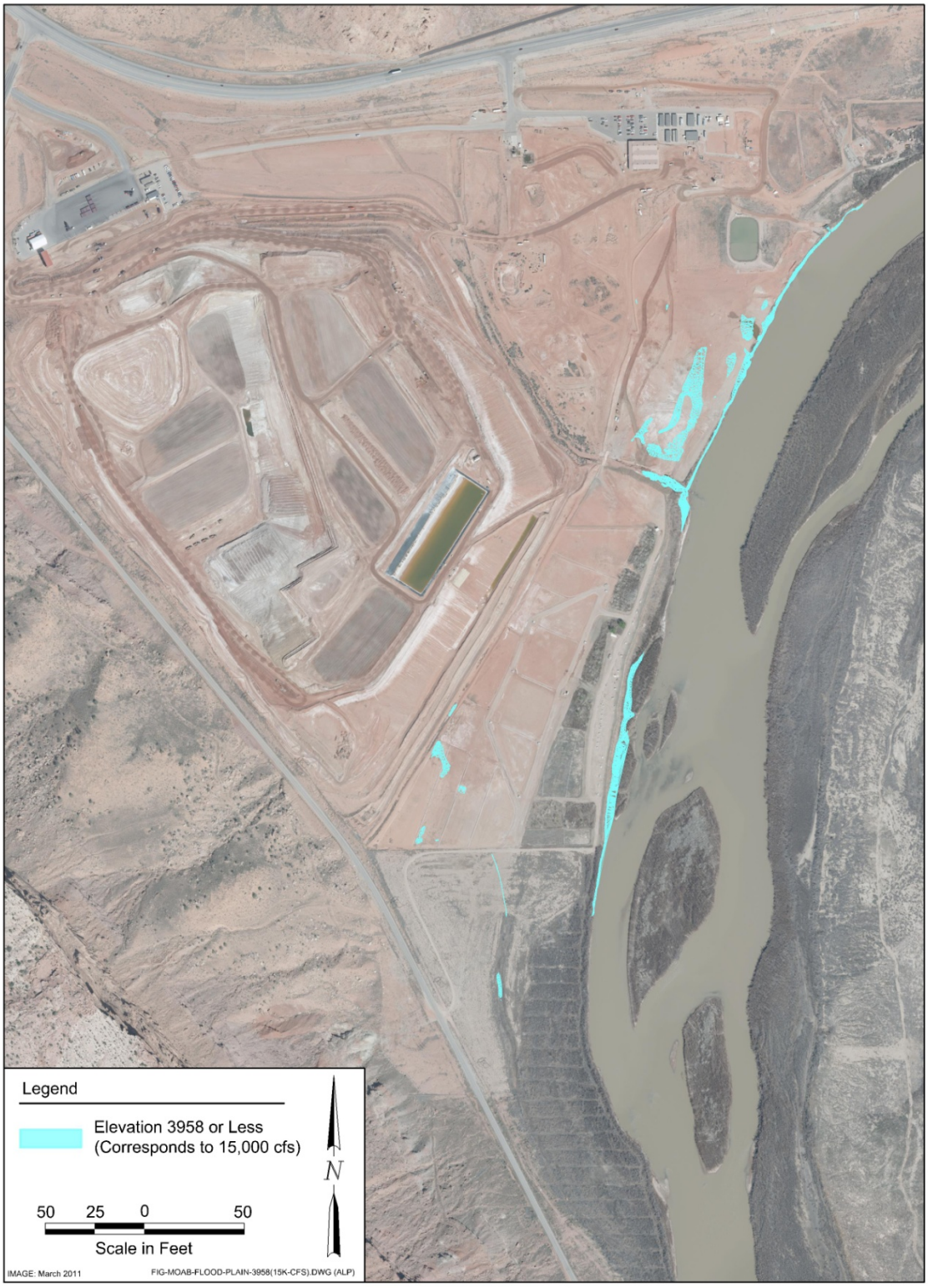

Figure A-1. Potential impact of 15,000 cfs

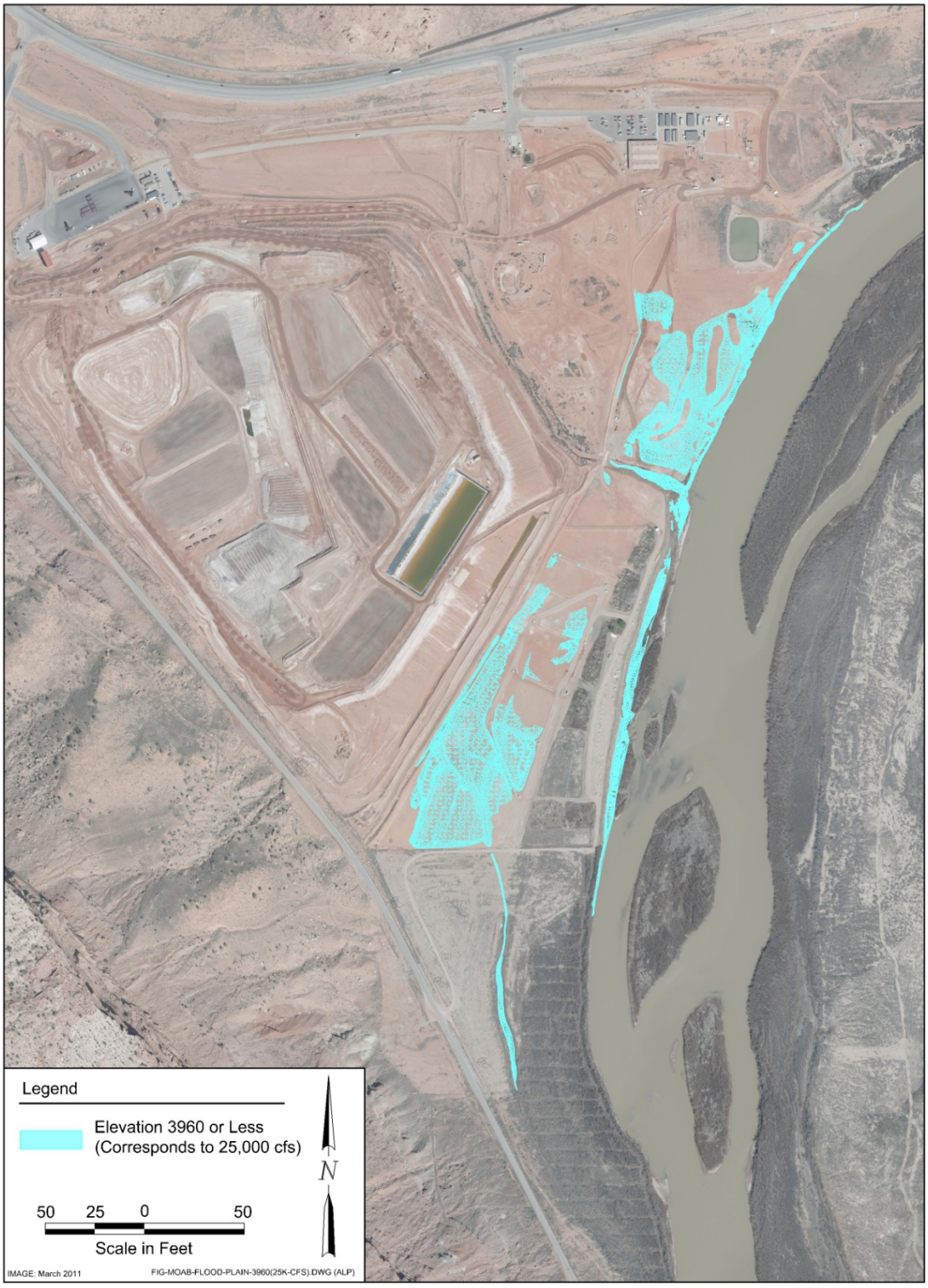

Figure A-2. Potential impact of 25,000 cfs

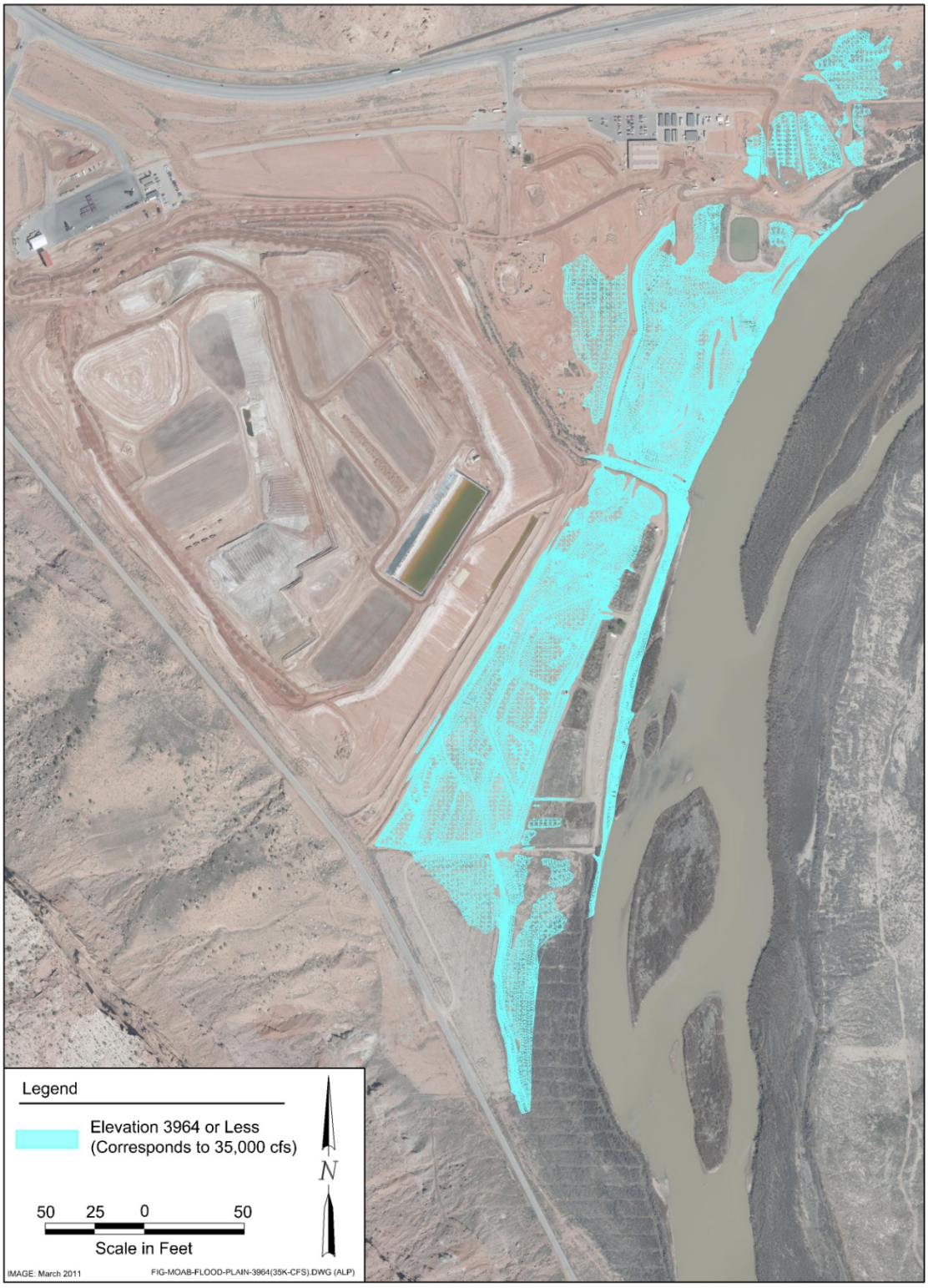

Figure A-3. Potential impact of 35,000 cfs

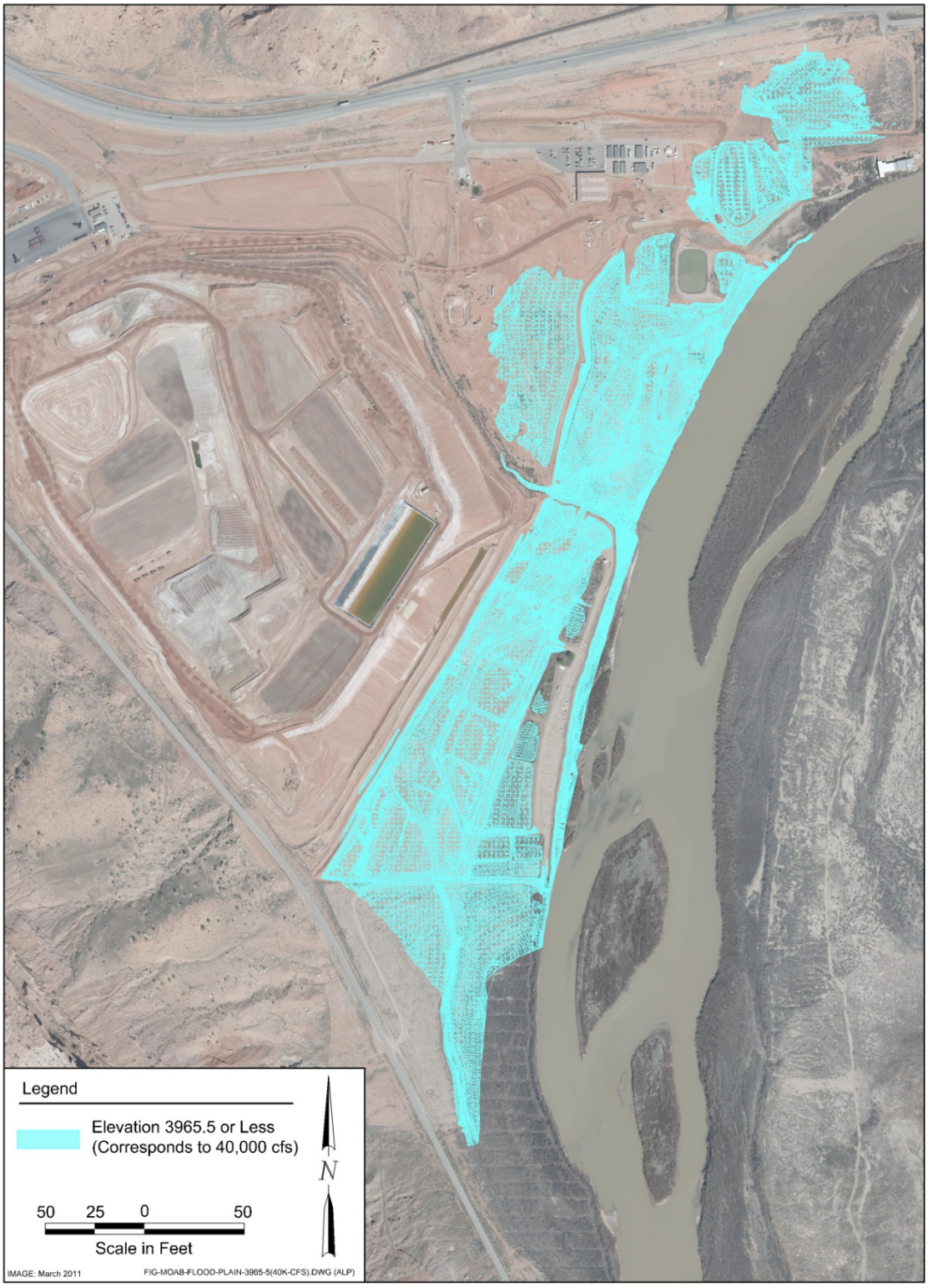

Figure A-4. Potential impact of 40,000 cfs